Smarter through social protection? Evaluating the impact of Ethiopia's safety-net on child cognitive abilities

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Abstract

We provide the first estimates of the impact of Ethiopia's Productive Safety Net Programme (PSNP) in Ethiopia on childrens academic achievement. PSNP is the second largest Social Protection Program in Africa, which has been rolled out to almost 10 million beneficiaries since 2005; its effects are therefore of general interest. To identify impacts we exploit four rounds of information on the same cohort of children surveyed between 2002 and 2013. We find a small but significant positive effect of the programme on both numeracy skills and vocabulary. This is driven mainly by children in households that had graduated (left) the programme just before 2013. We argue that this is at least partially related time allocation; graduates of the programme spent more time in school than continuing beneficiaries. We also find evidence that the maths (though not language) improvement is more pronounced for boys.

Keywords: Ethiopia, social protection, children, cognitive development.
JEL codes: I38, O22

1 Introduction

Can anti-poverty programmes which also contain a work requirement impact positively on children's futures? Creating evidence on the effectiveness of cash transfers, both conditional and unconditional, has become a huge area of research in the past ten years, and such programmes are now seen as a key pillar of the anti-poverty effort. In many countries, most notably India, South Africa and Ethiopia, workfare (or cash/food for work) programmes also comprise an integral component of the social protection strategy (Subbarao et al., 2012). Baird et al. (2014) review the impact of both conditional and unconditional cash transfers (CCTs and UCTs respectively), and find overall evidence that both of these do have a positive impact on enrollment and attendance at school. However, the authors find little evidence that cash transfers matter for learning outcomes, such as performance on cognitive achievement tests. The evidence on workfare programmes is rather more sparce. Mani et al. (2014) found India's flagship rural employment programme to have strong positive effects on grade progression and a number of cognitive skills tests, however Shah and Steinberg (2015) find both a negative effect on school enrollment and reduced test scores, for older children.

This paper contributes to filling the evidence gap on social protection and learning, using information on child cognitive achievement in Ethiopia, combined with information on participation in a national social protection scheme. The Productive Safety Net Programme (PSNP) was introduced in 2005, and is a broad social safety net with a workfare emphasis, implemented at scale in a low-income context. There has been considerable policy interest in the impact of the programme, given that it is the largest in sub-Saharan Africa outside of South Africa (Gilligan et al., 2009). Several evaluations have found that the programme has been well targeted overall, and that it had positive impacts on several dimensions of rural household wellbeing including an increase in households' reported months of food security per year, the official outcome target of the programme (see literature review for further details).

While the impact of the PSNP on poverty is becoming better established, the work requirement of the programme means that there could be an ambiguous effect on child outcomes such as cognitive achievement, through its impact on time-use of adults and children. In a situation where children substitute for adults on activities, e.g. inside the family farm or enterprise, or domestic tasks, this substitution effect could outweigh the (positive) income effect of the programme, leading to a reduction of children's time in school or studying. Also, if the time spent with parents has a positive impact on learning outcomes, an increase in parental time spent outside at work could have adverse effects.

This paper is structured as follows: the next section situates the paper in the literature, and gives a brief outline of the PSNP programme structure and background; section three lays out the conceptual framework and discusses the estimation strategy; section four presents the data used and describes the main characteristics of the PSNP beneficiaries and of the control group; section five presents the main empirical results and discusses the findings; and the final section concludes.

2 Background and related literature

2.1 Impacts of social programmes on child outcomes

The supportive evidence body is now quite convincing that investments in child human capital (and conversely, shocks to these investments) can have a significant impact on human capital attainments and achievements as adults (Alderman et al., 2006; Hoddinott et al., 2008; Dercon and Porter, 2014). Although the importance of early child development is well appreciated worldwide, attention is only beginning to be given to the extent to which social protection has the potential to impact child human capital outcomes, both through protection and promotion. We briefly review the most relevant literature. Thus far, most studies on child cognitive outcomes and social protection have been of conditional cash transfer programmes that have been rolled out initially in Latin America (Gertler, 2004; Fernald et al., 2008a; Barham et al., 2013).

Fernald et al. (2008b) show that Mexico's flagship conditional cash transfer programme, *Oportunidades*, is associated with a significant improvement in cognitive achievement as measured by vocabulary test, short and long-term memory tests (for children over 36 months).[1] Macours et al. (2012) find significant improvements in cognitive development of children exposed to a CCT in Nicaragua nine months after the program began. The authors hypothesise that the impacts are the result from the cash component combined with the conditionalities imposed on families, which they show through behavioural changes such as an increased expenditures on critical inputs into child development. Paxson and Schady (2010) show that an unconditional cash transfer programme in Ecuador improved cognitive outcomes for children, especially for the poorest children in the sample, for girls and for those with better-educated mothers. The authors show suggestive evidence that the channel of impact to cognitive development in this case operates through higher intake of nutrition and deworming, rather than through improved parenting or visits to health clinics, or maternal mental health. Beneficiaries of an unconditional cash transfer in Malawi showed a significant increase in school enrollment (Baird et al., 2011). The study also found a significant decrease in teenage pregnancy and fertility for the sample of adolescent girls. However, it did not find detectable improvements in school attendance or their test scores.

Evidence on the largest public works program in the world, India's Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), has shown mixed results for child outcomes. Mani et al. (2014) find MGNREGS to have strong positive effects on grade progression and a number of cognitive skills tests (reading comprehension test

[1] Vocabulary was measured by the Peabody Picture Vocabulary Test as administered by the YL survey, and memory tests from Spanish language version of the revised Woodcock-Muoz test.

scores, math test scores and Peabody Picture Vocabulary Test scores). Further, they found that the effect of the programme increases over time. However, Shah and Steinberg (2015) find that children in participant households had lower enrollment, and lower cognitive achievement. We know of no other studies on the effects of public works programmes on child cognitive outcomes.

2.2 PSNP and food aid in Ethiopia

The PSNP was introduced in Ethiopia in 2005 as a national programme replacing previous piecemeal responses to drought. Ethiopia has a history of chronic drought and food insecurity in rural areas, and many households were reliant on unpredictable emergency food aid. The innovations in the approach were a) a partnership between the Government of Ethiopia and a large number of donors (The World Bank, United Nations agencies and bilateral donors); and b) to provide predictable assistance. The objective of the PSNP is 'to provide transfers to the food insecure population in chronically food insecure woredas (districts) in a way that prevents asset depletion at the household level and creates assets at the community level' as well as to bridge the food gap that arises when, for these households, food production and other sources of income are insufficient given the food needs (Ministry of Agriculture and Rural Development, 2004).

The PSNP transfers to poor households mainly (80%) through public works, with less than a fifth of households receiving direct support, in the absence of adult labour available in the household. In 2013, the year of our study, the PSNP supported 7.2 million people (roughly 10% of the national population) in 290 chronically food insecure woredas in 8 of the country's 10 regions. Phase 3 from 2010-2015 attempted to improve timeliness and predictability of transfers, strengthen public works and accountability, as well as the Household Asset Building Program (HABP, see (Holmemo, 2014)). In September 2014, Phase 4 of the PSNP was announced, to last until 2020.[2]

[2]http://www.worldbank.org/en/news/loans-credits/2014/09/30/ethiopia-productive-safety-nets-

PSNP beneficiaries are entitled to work five days per household member (aged 18-60) per month (Sharp et al., 2006), though we note below some evidence suggests that under-18s were working on the programme despite this rule. Despite a cash-first principle, only 15% received cash exclusively, 18% received food exclusively, and 67% received a cash-food mix in 2012/13 (DFID, 2013). In 2010-11, median transfer values were just under 500 birr (c. 20) per year for a household of five, equivalent to 13% of the value of the poverty line (DFID, 2013). About 84.5% of transfers received had a cash equivalent value of at least 15kg of grain per month per person (food wage). This figure went up for food and down for cash during 2012/13 mainly due to inflation and the real value of cash going down. The goal is that the PSNP should improve household food security up to the point that it graduates (leaves the programme). This is defined as : "A household has graduated when, in the absence of receiving PSNP transfers, it can meet its food needs for all 12 months and is able to withstand modest shocks." Since 2005, approximately 500,000 beneficiaries have been graduated from the PSNP (Hoddinott, 2014). Non-random programme placement of the PSNP means it has been historically targeted towards food-insecure households. This leads to challenges in finding a convincing identification strategy when assessing the impact of the programme.

PSNP has overall been found effective in improving household level measures of food security and consumption (Yablonski, 2007; Berhane et al., 2014). In Berhane et al. (2014), beneficiaries who had received the programme for at least three years experienced improvements in their food security. The comparison group of those who received PSNP for only one year showed no impact of being in the scheme compared to non-participants. Other studies have found that households enrolled in the PSNP avoided selling assets in situations of food shortages, and 36% avoided using savings to buy food (Alderman and Yemtsov, 2012). Participant households are also more likely to consume the required 1,800 calories per day than non-beneficiaries (Save the Children UK, 2008).

project-4, last accessed 19th Dec 2017.

The limited evidence suggests that the PSNP has had both intended and unintended outcomes for children. The conflicting evidence discussed below may be due to different methodologies used in the literature and differing samples. Porter and Goyal (2016) find that by 2009, the PSNP had a net positive impact on child nutrition. A study for USAID (2012) finds statistically significant evidence of increased number of meals consumed by children from households in public works. Hoddinott et al. (2010) find neither positive nor effects of the PSNP on school attendance on average, using the official PSNP evaluation survey, with older girls benefiting, but not younger girls (and no effects for boys). The study does find reductions in boys' and older girls' hours of work which is larger for those who received bigger transfers, however an increase in working hours for younger girls (aged 6-10). Nevertheless, studies that include qualitative methods do find more evidence on children increasing their working hours, though this contrasts with the quantitative results. Tafere and Woldehanna (2012) for example find negative programme effects with regard to child time use. The authors argue that the programme increased time spent on both paid and unpaid work. Camfield (2014) also finds considerable evidence of girls working in the PSNP programme, or increasing their household chores in response to caregivers' participation in the programme, though this in a smaller qualitative sample.

We would therefore expect participation in the PSNP to have a positive effect on the cognitive outcomes of participant household children through a positive income effect, if the improvements in nutrition found above translate into improved cognition (Behrman and Rosenzweig, 1996). However, if labour supply demands on adults change children's time use, known as the "substitution axiom" (Basu and Van, 1998), there may be adverse time-use effects and a negative effect on child's cognition. Therefore, given this ambiguity in the theoretical net effect of the programme, we investigate whether PSNP improved cognitive outcomes given the work requirement and other risks faced by households in the years up to 2013 (the latest survey round).

3 Methodology

3.1 Production of Child cognitive achievement

Our estimates of the impact of the safety net on child achievement are nested in a theoretical framework that reflects the literature on the production of skills in children, drawing particularly on the works of Todd and Wolpin (2003, 2007), Cunha and Heckman (2007, 2008) and Andrabi et al. (2011). These papers provide a theoretical basis for the understanding of the determinants on child development, as well as the assumptions that are implicit in empirical specifications that attempt to estimate them.

The production of child skills, known also as human capital, or achievement, is often modelled as a function of household and school inputs, as well as the child's innate abilities and inputs (e.g. time spent on educational activities).

A general production function for achievement is shown below (Todd and Wolpin, 2007):

$$A_{ika} = A_a \left(X_{ik}(a), \mu_{ik0} \right) \tag{1}$$

Where A_{ika}, the achievement or skill of child i in household k at age a is a function of X_{ik}, generalised to contain all inputs (contemporaneous and past), at child, household and school/community level as well as an initial endowment, or ability (μ_{ik0}) vector of child-specific characteristics such as sex, age, inherited healthiness/intellectual potential. Not all of these are observable. We note that this production function for learning is a structural relation.

Das et al. (2013) argue that caution is needed when interpreting cash grants received as a parameter in such an education production function. This is a pertinent point for our research question, as noted above, money received from PSNP (which may have a positive income effect) comes with an adult time-use implication (which may have a negative substitution effect for child time-use).

In this spirit, we follow Glewwe and Muralidharan (2016) separating the production function into a vector comprising

$$A = f(S, Q, C, H, I) \tag{2}$$

Where: S=years of schooling; Q=vector of quality (school and teacher characteristics); C=child characteristics (ability, motivation); H=household characteristics (financial, time constraints, parental education); I=inputs at household level (school attendance, encouragement to do homework etc).

Parents maximise household utility, $U = (.)$, where U will contain consumption and leisure of the adults, as well as consumption and schooling of the children. The constraints to maximisation are i) the production function of achievement, ii) the rate of return to achievement and iii) other income constraints (household labour requirements, credit constraints) as well as the price of schooling, P. Parents will therefore make decisions on inputs, and on school attendance based on this framework. PSNP will impact directly on the budget constraint and on the time constraint of adults. If adults are not fully employed when they enter the programme, then there will be no time-use effects on children. However if they are working on other tasks up to their maximum time available, and if children can substitute (possibly less efficiently) for adults on other tasks, then this could affect child time use.

If C and H are exogenous (given) and assuming that there is only one local school and that parents are unable to influence the school (i.e. assume Q and P to be fixed), parents choose S and I as part of the utility maximisation exercise. Glewwe and Muralidharan (2016) show that S and I can then be written in terms of exogenous variables:

$$S = f(Q, C, H, P) \tag{3}$$

$$I = g(Q, C, H, P) \tag{4}$$

Insert 3 and 4 into 2 gives us the reduced form equation for achievement which can be considered as causal, but not a production function

$$A = h(Q, C, H, P) \tag{5}$$

since it reflects prices, preferences, and potentially behavioural responses to any policy change. PSNP would directly affect H as it increases household income. We noted above that whether this translates into cognitive achievement for the child will depend on household preferences.

Todd and Wolpin (2003, 2007) show that under the assumption that effect of inputs (both observed and unobserved) as well as that of initial ability decline geometrically over time, then a "lag value added" empirical model can be specified, using only the immediate lag of achievement to serve as a proxy for all previous inputs, and ability.

$$A_{ika} = X_{ika}\alpha + \gamma A_{ik,a-1} + e_{ika} \tag{6}$$

The lagged "value added" model specified in equation 6 has slightly less restrictive assumptions than a first difference model, and the vector X contains the elements of Q, C, H, P.

We note that our main estimates are of the full policy effect of the programme on cognitive achievement, taking into consideration all ex-post household responses. The channels through which the programme may affect cognitive ability are specifically: a) the income effect - this will be positive depending on i) whether increased income is spent on goods likely to improve cognitive ability (increased volume or quality of food for the child, books or other educational inputs) and b) the substitution effect, which is likely to be negative if child labour is a substitute for adult labour either on the programme directly, or more likely, substituting on household chores (family farm, housework) while adults work on the programme. The income effect is likely also related to the intrahousehold allocation preferences of each household - some evidence shows that e.g. if women have higher bargaining power, then children may be allocated more goods (Doss, 2013). Fiorini and Keane (2014) outline the importance of incorporating the full time use vector as part of the child-level inputs into cognitive achievement. We do this as a robustness check. It allows us to understand the importance of children's working/school/study time in the Ethiopian context, given that it is a possible channel through which the programme may affect cognitive development of children.

3.2 Empirical strategy

Our empirical strategy is based on the literature on cognitive ability summarised in section 3.1. Our estimating equation as noted above is a conditional demand function for child cognitive ability (Glewwe and Miguel, 2007; Glewwe and Muralidharan, 2016).

The empirical analogue to equation 5 above is expressed in levels as:

$$A_{ika} = \alpha + \beta_1 A_{ika-1} + \beta_2 PSNP_{ka} + \beta_3 K_{ka} + \beta_4 Z_{va} + \lambda_v + \epsilon_{ia} \tag{7}$$

Lagged achievement enters directly, A_{ika-1}. PSNP is the time-varying treatment variable identifying beneficiary households; K_{ka} and Z_{va} are vectors of contemporaneous time-varying observable household and child characteristics. λ_v represents community (unobservable) fixed effects.

The impact of the programme on achievement is β_2, and the long term impact of the programme is then equal to $\beta_2/(1-\beta_1)$ (Andrabi et al., 2011). The framework outlined in the literature review showed that the inclusion of A_{ika-1} is crucial for the estimation of a) the dynamics of the conditional demand function and relatedly b) the long-term impact of any intervention in time t. To the extent that A_{ika-1} captures unobservable child, household and community characteristics that may affect programme placement, this allays concerns about the non-random nature of the PSNP. However, we also present results for a child fixed effect specification (which by construction also includes household fixed effects).

We estimate two specifications of equation (7): in the first specification, we estimate the overall effect of PSNP by defining PSNP as a binary variable, equals to one if any member of the household has participated in PSNP in the twelve months before the survey and zero otherwise.[3] The second specification estimates the persistent of the effect of PSNP by comparing those household who graduated from the program before 2013 and those who are still receiving PSNP in 2013. In both specifications, we control for the gender of the child (a dummy equal to 1 if the child is male and equal to 0 otherwise), the child's age in month (in 2013), and the socio-economic status of the household at age 5 measured through a wealth index, a composite measure of living standards capturing housing-quality, access-to-services and a durables consumption index.[4] Finally, a more conservative version of the second specification includes maternal education (a dummy equal to 1 if the mother as at least completed primary education, and equal to 0 otherwise) and a vector of dummy variables capturing environmental shocks (drought, flood, crop failure), economic shocks (illness of household member, death of father, death of mother) and the total number of shock which hit the household between 2006 and 2009 (when the child was aged 5 and 8, respectively) and between 2009 and 2013 (when the child was aged aged 8 and 12, respectively).

[3]Most households who received the programme in 2009 reported receiving since 2006-7. If households received the programme in 2013 and in 2009 we assume that treatment was uninterrupted. For the fixed effects specification, we consider 'post treatment' for participant households as 2009 and 2013, since otherwise graduates would appear to be untreated in 2013.

[4]The wealth index takes values between 0 and 1, such that a larger value reflects a wealthier household. It is the simple average of an housing-quality index, an access-to-services index and a consumer-durables index (Briones (2017)). In the analysis we use tertiles of wealth index using those households in the bottom tertile of the wealth-index distribution as reference group.

4 Data

We use the Young Lives study panel data from Ethiopia, a longitudinal household data set conducted over four waves. The first survey took place in 2002 with three further rounds of data collection in 2006/7, 2009/10 and 2013/14. The younger cohort of the study were aged 6 to 18 months in 2002, and the older cohort were aged 7-8 years. Overall the attrition rate is about 2.2 percent for the 2001/2003 cohort and 8.4 percent for the 1994/95 cohort since the start of the study. In the present analysis, we use the younger cohort data. The dataset comprises children from 20 sentinel sites in the states of Amhara, Oromia, the Southern Nations, Nationalities and Peoples Region (SNNP), Tigray, and Addis Ababa. These were purposively sampled to represent the different regions in Ethiopia with a pro-poor focus. Households within sites were chosen randomly among those that had children who were born in the stipulated year. Importantly, in 2013 PSNP was operating in 14 of these sites with 398 out of the 1873 households (21.3% of the sample) being active beneficiaries of the programme. The coverage of the program was highest in rural areas (349 out of 398 total beneficiaries in 2013) where the PSNP was operating in 11 of the Young Lives sites.

In all rounds, three main questionnaires were administered to capture various characteristics that are expected to influence the status of the child: a child questionnaire with data on child health, anthropometrics and individual characteristics; a household questionnaire including data on caregiver background, livelihood, household composition, socio-economic status, shocks; and a community questionnaire containing information on demographic, geographic and environmental characteristics, social environment, infrastructure, the economy, health and education.

Households were asked whether they had received payments from public works or direct support within the PSNP framework in 2006, 2009 and 2013. They were also asked the details of which years they were enrolled in the PSNP and how much (cash or in-kind payment) they had received in the past 12 months. They were also asked if they had to their knowledge been shortlisted for the programme or whether they had graduated from the programme, as well as their perceptions of how fair enrollment into PSNP had been.[5]

Our outcome variables for cognitive achievement are the Peabody Picture Vocabulary Test (PPVT), a widely-used test of receptive vocabulary Dunn and Dunn (1997), and a mathematics test that was developed by the Young Lives survey team for the purposes of the survey, and is adapted to be appropriate for each round of the survey (Cueto et al., 2009; Cueto and Leon, 2012). We standardise the scores by age in order to create a z-score, allowing comparison across years, and to implement the "value added" approach. The PPVT score used in this paper is constructed using Item Response Theory (IRT) models which are commonly used in international assessments such as PISA and TIMSS (see Leon and Singh (2017) for further details).

4.1 Treatment and control groups

Table 1 reports information on some basic characteristics of the regression sample. The regression sample includes only those children observed across all the four rounds of data collection (dropping 133 children) and living in rural areas (dropping 613 children) since the PSNP is a rural programme. We also dropped children living in households which only started receiving the PSNP in 2012, just before the final round of data collection (dropping 108 children).[6] We define households as treated if they answered *yes* to the question on PSNP participation (either food or cash for work, or direct transfers of food or work). Figure 1 shows the timing of the four survey rounds as well as the introduction of the PSNP and subsequent rollout. Table 2 shows the number of beneficiaries in each

[5] We investigated this information to see whether it could be used to establish more nuanced treatment variables, but we found it to be too incomplete to be of use.

[6] The final sample for the math regression model is 947, 42 observations are dropped due to missing data from the control variables and the PPVT sample is 824, the difference due to those missing a PPVT score in any of the rounds being dropped.

year of the survey. In our sample, about 15% of the households received PSNP in 2009 but graduated from the programme by 2013 and about 26% were still benefiting from the programme in 2013. The remaining households (about 59%) never received PSNP. We consider these households as a "broad control group".

Identification of the treatment effect in any PSNP study is complicated by the fact that the programme was not randomly allocated. Table 3 compare the group of PSNP beneficiaries to the control group at baseline when the child was 5 years old. It suggests, as expected, that the control group tends to be richer as measured by the wealth index and consumption, and more educated, than PSNP beneficiaries at baseline. Also children from those household spend on average more time in school and studying than children from PSNP beneficiary households, and have lower test scores and height-for-age. Comparing the PSNP-treated households with non-treated as such would likely bias the impact downwards, as those who never received PSNP are presumably different.

For this reason we construct a "more restricted" comparison group arguably more comparable to the PSNP beneficiaries households. In this we include only 1) those who received any kind of government programme (food for work, cash for work, food aid) in 2006 as the baseline control group since they were in some sense eligible for PSNP, and therefore likely quite similar to eventually treated households; 2) the households who reported in 2009 that they had been shortlisted for PSNP, as we know that whilst community-level shortlists were drawn up, some households did not receive PSNP due to budget allocations not being sufficient from the next level of administration.

Bearing in mind that the PSNP was rolled out in 2005-2006, it is not completely clear that the beneficiaries in 2006 were reporting that they received PSNP, or whether it was food or cash for work from a previous incarnation of the programme, but we presume the latter.

Table 4 compares the baseline characteristics of the beneficiaries with the more restricted comparison group. Here we see that the differences between treatment and control group are now much less, and with only a few exceptions are not significant in wealth, non-food expenditure or time use.[7]

5 Results

Table 5 and table 6 shows the main results, respectively for the math test and for PPVT using the value-added model. In table 5 the standardized score of the math test measured in 2013 at age 12 is the dependent variable, and the lag of maths achievement is measured in 2006, at age 5. We assume that the lag achievement captures investments up to age 5, as well as innate ability and other unobserved household and child characteristics. We include community fixed-effects also to capture unobservable community effects that may for example affect PSNP delivery and school quality.[8] In table 7 and 8 we show child fixed effects results. This has the dependent variable as the test score from all three rounds of the dataset 2006, 2009 and 2013.[9]

The value-added results using the broad control group show some impacts of the PSNP program on cognitive achievement (column 1-3). These show no average effect of the programme on math achievement (Table 5, column 1). However, the results for maths are significant for the group of children in households that graduated from PSNP just before the survey (column 2 and 3). The impact of approximately 0.14 standard deviations is quite large, and around a third of results from conditional cash transfers of children "treated" at younger ages (Gertler, 2004).

In columns 4-6 we show the results using our more restrictive (and arguably more

[7]Children from graduated families spend less time in school and studying that the control group children and they are less likely to be in the top tertile of the wealth index. There are still fewer mothers with greater than primary education in the treated group, who also spend less on non-food items than the control group. Finally, the maths z-score at baseline is lower for those children in households that continue to be beneficiaries of the programme in 2013.

[8]Community fixed effect included for Maths models, while in PSNP we control for language dummy which cannot be combined with the community fixed effect, as language is homogeneous within most communities.

[9] The test language for the PPVT in each round is the same for all but 33 children. The results presented are robust to excluding these children.

comparable) definition of the comparison group. Here we do find an average effect of the programme on maths outcomes (column 4). This still appears to be driven by the 2012 graduates (columns 5 and 6). The effect magnitude is higher (between 0.25 and 0.22 standard deviation), approaching that of the CCT results noted above. However, we acknowledge that this sample is much smaller.

The results (both using the broad control group and the restricted one) are robust to the inclusion of ever more stringent controls including education inputs, time use, nutrition, and household expenditure (not reported). Further work needs to establish the mechanism behind this result, for example whether this means that the right households are indeed graduating from the programme, or whether it is selection of households that are both more capable and more concerned with child cognitive development. We discuss this further below. The results in table 7 confirm similar results when using the fixed-effects estimator (not differentiating between graduated and continuing households).

In table 6 we show the results for the PPVT value-added model. For this measure of cognition we find no significant effects of the programme at all. However, the fixed-effects model presented in table 8 does show significant programme impacts, an improvement of approximately 0.3 standard deviations, for both restricted and broad samples. Studying the nature and sources of growth across a number of cognitive skills, Christian et al. (2009) find schooling influences mathematics (and reading recognition, letter recognition, general information, phonemic segmentation skills) but did not appear to shape children's growth in receptive vocabulary (and syllabic segmentation). This could be one reason why we find slightly less robust results for PPVT than maths.

We interacted the treatment with gender in the value-added model and found no significant results. Splitting the sample by gender and running the fixed-effects model (on both restricted and broad sample) shows that the maths results appear to be driven by the effect on boys (table A.2, columns 1-4), whereas in the girl-only sample the coefficient on PSNP is no longer significant. For PPVT we do not see differences by gender in either model (columns 5-8). We also incorporated the older cohort of the survey (aged 18 years) as well as siblings, but did not find any significant differences in the results for those groups compared to the index children. In terms of modality of delivery, the PSNP comprises both public works and unconditional cash transfer (direct support). We dropped the small number (37) of households who only reported receiving direct support, and found no difference to the main results. Unfortunately this small number does not lend itself to further in-depth analysis of the effect of the work requirement on child wellbeing.

In table 9 we examine some of the characteristics of the graduating households to see what might be the drivers of the heterogeneous impact of the programme on cognitive achievement. We see that the graduating households do have significantly higher expenditure on both food and non-food than the households who continue in the programme, suggesting that in this sample, the graduation criteria may be being adhered to. Children also spend significantly longer time in schooling than either the comparison children or those in households that remained in the programme, which is a plausible mechanism of effect, especially for mathematics.

6 Conclusion

We have examined the impact of the Productive Safety Net Programme on child cognitive outcomes. The PSNP has previously been shown to have positive effects on household consumption and food security, but mixed effects on child wellbeing (positive on nutrition, possibly negative on time use). The identification of programme effects is problematic given the non-random placement of PSNP. However, we include baseline cognitive test scores (year 2006) which allows us to estimate a conditional demand function for cognitive achievement, including the lagged dependent variable in the spirit of the value-added approach. We supplement this with estimates from a child-fixed effects model which shows consistent results.

Our results, based on information from 2013, when the children were 12 years old, do show a positive impact of the PSNP on child cognitive outcomes, as measured by mathematics test scores, which is fairly stable across specifications. We also find a significant effect on receptive vocabulary as measured by the PPVT test score, when using the child fixed effects model. The effect sizes are smaller in magnitude than those that have been estimated for conditional cash transfers in Latin America. This result is to be expected, given that the programme does have a work requirement for adults, that could lead to substitution of child time into household chores or caring for others, or a diversion of adult attention from children. We do see that the PSNP participant children spend less time studying than non-participants. However, graduates of the programme spent more time in school than either comparison children, or those in households that remained in the programme. The results of course are only for a particular cohort of children and evidence suggests that programme effects are likely to vary with age (Barham et al., 2013). We also find that if anything, the programme effects are driven by boys. This resonates with other work using the Young Lives sample which found that rural boys' working hours had not fallen over time unlike those of rural girls or urban boys and girls (Boyden et al., 2016), and suggest that the income effect may be dominating the substitution effect.

The results appear suggestive that the programme can have a positive effect on child cognitive outcomes. We also note that recent initiatives to make the PSNP more nutrition-sensitive, combined with targets for improved delivery may also increase the effectiveness of the programme for children in future (Roelen et al., 2017).

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7 Tables

Table 1: Descriptive statistics

	Mean	Std. Error	N
Cognitive skills			
PPVT (IRT, R4)	1.69	(1.228)	822
PPVT (IRT, R2)	-0.26	(0.951)	760
Math (z-score, R4)	0.01	(1.005)	947
Math (z-score, R2)	0.01	(1.011)	947
Socio-economic status			
Wealth Index (R2) : bottom tercile	0.51	(0.500)	947
Wealth Index (R2): mid tercile	0.37	(0.484)	947
Wealth Index (R2): top tercile	0.12	(0.327)	947
Mother's education: primary and above	0.44	(0.497)	947
Demographics			
Male	0.55	(0.498)	947
Age (in months) at R4	145.87	(3.916)	947
Shocks in R3 (2006-2009)			
Drought	0.49	(0.500)	947
Flood	0.19	(0.396)	947
Crop Failure	0.38	(0.486)	947
Illness of household member	0.46	(0.499)	947
Death of father	0.04	(0.194)	947
Death of mother	0.03	(0.181)	947
Number of shocks	1.85	(1.357)	947
Shocks in R4 (2009-2013)			
Drought	0.20	(0.397)	947
Flood	0.10	(0.299)	947
Crop Failure	0.26	(0.440)	947
Illness of household member	0.19	(0.392)	947
Number of shocks	0.83	(1.086)	947
Time use (Hours spent on) (R4)			
Working	4.80	(1.867)	947
Schooling	5.71	(1.795)	947
Studying outside school	1.40	(0.836)	947
Expenditures (R4)			
Food expenditure (monthly, in birr)	295.54	(161.150)	947
Non-food expenditure (monthly, in birr)	151.68	(193.645)	947
% expenditure on education	0.01	(0.015)	947

Figure 1: PSNP and survey timing

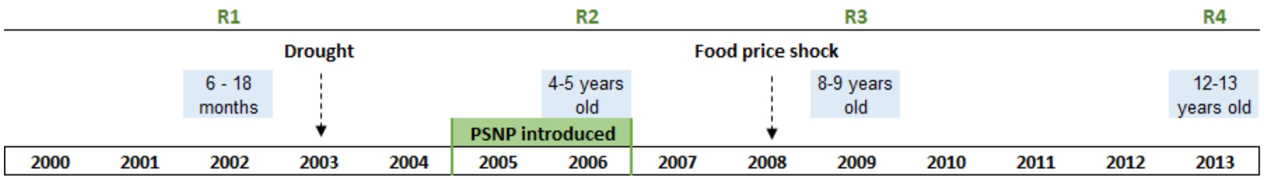

Table 2: PSNP Beneficiaries

PSNP Groups	**Obs**	**Percentage**
Non-beneficiaries	561 (190)	59.2% (33.0%)
2009 PSNP only	140	14.8% (24.3%)
2009 & 2013 PSNP	246	25.9% (42.7%)
Total	947 (576)	100.0%

Notes: Regression sample only. Numbers in parentheses represent the restricted sample as outlined in the text in section 4.1.

Table 3: Control and Treatment groups: baseline characteristics (using broad control group)

	Control		2009 only PSNP		2009 & 2013 PSNP		T-tests C-2009 PSNP	T-tests C-2009&13 PSNP
	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev	p-value	p-value
Math (z-score)	0.06	(0.043)	0.01	(0.089)	-0.10	(0.063)	0.557	0.038
PPVT (IRT)	-0.20	(0.047)	-0.37	(0.085)	-0.32	(0.062)	0.064	0.118
HAZ	-1.43	(0.045)	-1.47	(0.075)	-1.65	(0.068)	0.693	0.008
Mother's educ.:								
$\geq$ primary	0.39	(0.021)	0.21	(0.035)	0.26	(0.028)	0.000	0.000
Household size	6.10	(0.086)	6.55	(0.159)	6.09	(0.122)	0.018	0.967
Wealth Index								
Bottom tercile	0.46	(0.021)	0.59	(0.042)	0.57	(0.032)	0.004	0.002
Mid tercile	0.39	(0.021)	0.36	(0.041)	0.34	(0.030)	0.597	0.167
Top tercile	0.16	(0.015)	0.04	(0.017)	0.09	(0.018)	0.000	0.012
Expenditure								
Food expenditure	90.11	(2.704)	81.18	(5.759)	78.22	(3.792)	0.146	0.013
Non-food expenditure	43.14	(2.113)	25.09	(1.647)	27.97	(1.390)	0.000	0.000
% expenditure on educ.	0.01	(0.001)	0.01	(0.001)	0.01	(0.001)	0.087	0.012
Time use (hours)								
Working	2.45	(0.141)	2.91	(0.342)	2.40	(0.227)	0.197	0.849
Schooling	1.10	(0.090)	0.61	(0.074)	0.77	(0.096)	0.014	0.035
Studying outside school	0.10	(0.019)	0.01	(0.012)	0.03	(0.014)	0.046	0.048

Note: All variables are measured at round 2 (2006). Average values; standard deviation reported in parentheses. The PPVT score reported is the MLE from the IRT models. Math score is the math test raw score standardized within the sample.The p-values for a t-test for differences in means between control group and the PSNP groups are reported in the last two columns. "Working" is defined as the sum of hours spent caring for household members, house chores, unpaid work and paid work.

Table 4: Control and Treatment groups: baseline characteristics (using restricted control group)

	Control		2009 only PSNP		2009 & 2013 PSNP		T-tests C-2009 PSNP	T-tests C-2009&13 PSNP
	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev	p-value	p-value
Math (z-score)	0.12	0.068	0.01	0.089	-0.10	0.063	0.299	0.020
PPVT (IRT)	-0.28	0.079	-0.37	0.085	-0.32	0.062	0.436	0.722
HAZ	-1.56	0.070	-1.47	0.075	-1.65	0.068	0.381	0.377
Mother's educ.:								
$\geq$ primary	0.36	0.035	0.21	0.035	0.26	0.028	0.005	0.030
Household size	6.20	0.142	6.55	0.159	6.09	0.122	0.105	0.569
Wealth Index								
Bottom tercile	0.52	0.036	0.59	0.042	0.57	0.032	0.196	0.279
Mid tercile	0.37	0.035	0.36	0.041	0.34	0.030	0.862	0.433
Top tercile	0.11	0.022	0.04	0.017	0.09	0.018	0.038	0.580
Expenditure								
Food expenditure	85.22	4.439	81.18	5.759	78.22	3.792	0.572	0.229
Non-food expenditure	33.38	2.033	25.09	1.647	27.97	1.390	0.003	0.024
% expenditure on educ.	0.01	0.001	0.01	0.001	0.01	0.001	0.709	0.448
Time use (hours)								
Working	2.68	0.246	2.91	0.342	2.40	0.227	0.579	0.414
Schooling	0.96	0.146	0.61	0.074	0.77	0.096	0.071	0.259
Studying outside school	0.08	0.029	0.01	0.012	0.03	0.014	0.079	0.138

Note: All variables are measured at round 2 (2006). Average values; standard deviation reported in parentheses. The PPVT score reported is the MLE from the IRT models. Math score is the math test raw score standardized within the sample.The p-values for a t-test for differences in means between control group and the PSNP groups are reported in the last two columns. "Working" is defined as the sum of hours spent caring for household members, house chores, unpaid work and paid work.

Table 5: PSNP Impact on Maths scores at age 12

	Broad control group			Restricted control group		
	(1)	(2)	(3)	(4)	(5)	(6)
PSNP	0.051			0.161*		
	(0.075)			(0.090)		
2009 beneficiaries only		0.136*	0.129*		0.250**	0.221**
		(0.076)	(0.073)		(0.085)	(0.085)
2009 & 2013 beneficiaries		-0.004	-0.033		0.101	0.057
		(0.076)	(0.078)		(0.093)	(0.088)
Math (z-score, age 5)	0.131***	0.130***	0.120***	0.121**	0.119**	0.115**
	(0.040)	(0.040)	(0.038)	(0.042)	(0.043)	(0.042)
Socio-economic status (R2)	x	x	x	x	x	x
Demographics	x	x	x	x	x	x
Shocks (R3)			x			x
Shocks (R4)			x			x
Community fixed effect	x	x	x	x	x	x
Constant	-2.384***	-2.337***	-2.219***	-1.633	-1.524	-1.554
	(0.669)	(0.665)	(0.655)	(1.253)	(1.251)	(1.086)
Observations	947	947	947	576	576	576
R-squared	0.118	0.120	0.151	0.116	0.119	0.161

Note: The table reports the OLS estimates with standard errors (reported in parentheses) clustered at community level. * $p<0.1$ ** $p<0.05$ *** $p<0.01$. The dependent variable is maths test score measured at the age of 12 and standardized within the sample by age (round). All controls are included as specified (see Section 3.2). Columns (1)-(3) sample includes the broad control group; columns (4)-(6) the restricted control group.

Table 6: PSNP Impact on Language scores at age 12

	Broad control group			Restricted control group		
	(1)	(2)	(3)	(4)	(5)	(6)
PSNP	0.025			0.103		
	(0.074)			(0.091)		
2009 beneficiaries only		0.048	0.072		0.130	0.069
		(0.095)	(0.095)		(0.115)	(0.120)
2009 & 2013 beneficiaries		0.014	0.041		0.089	0.027
		(0.087)	(0.059)		(0.098)	(0.081)
PPVT (IRT, R2)	0.171***	0.171***	0.148***	0.148***	0.148***	0.143***
	(0.041)	(0.042)	(0.038)	(0.041)	(0.041)	(0.042)
Socio-economic status (R2)	x	x	x	x	x	x
Demographics	x	x	x	x	x	x
Shocks (R3)			x			x
Shocks (R4)			x			x
Language	x	x	x	x	x	x
Constant	-1.655	-1.630	-0.684	-1.255	-1.212	-0.541
	(1.137)	(1.140)	(1.093)	(1.642)	(1.641)	(1.364)
Observations	824	824	824	568	568	568
R-squared	0.265	0.266	0.326	0.242	0.242	0.331

Note: The table reports the OLS estimates with standard errors (reported in parentheses) clustered at community level. * p<0.1 ** p<0.05 *** p<0.01. The dependent variable is the PPVT score measured at the age of 12 and standardized within the sample using Item Response Theory (Leon and Singh, 2017). All controls are included as specified (see Section 3.2). Columns (1)-(3) sample includes the broad control group; columns (4)-(6) the restricted control group.

Table 7: PSNP impact on Maths: Fixed effects estimates

	Broad control group		Restricted control group	
	(1)	(2)	(3)	(4)
PSNP	0.121*	0.084	0.236***	0.217***
	(0.064)	(0.064)	(0.072)	(0.075)
Wealth Index: mid tercile	0.050	0.049	0.082	0.085
	(0.056)	(0.055)	(0.068)	(0.068)
Wealth Index: top tercile	0.187**	0.176**	0.290***	0.284***
	(0.083)	(0.083)	(0.109)	(0.109)
Age (in months)	-0.001**	-0.001	-0.004***	-0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Drought		-0.055		-0.033
		(0.064)		(0.079)
Flood		-0.135*		-0.224**
		(0.074)		(0.092)
Crop Failure		0.036		-0.002
		(0.064)		(0.078)
Illness of household member		0.049		0.021
		(0.074)		(0.094)
Number of shocks		0.067		0.049
		(0.041)		(0.052)
Community fixed effect	x	x	x	x
Constant	0.086	-0.057	0.115	0.007
	(0.759)	(0.757)	(0.726)	(0.726)
Observations	2,800	2,800	1,702	1,702
R-squared (within)	0.013	0.024	0.024	0.033
Number of children	946	946	575	575

Notes: The table reports child fixed effects estimates with standard errors (reported in parentheses) clustered at community level. * $p<0.1$ ** $p<0.05$ *** $p<0.01$. The dependent variable is the Maths score measured at the age of 5, 9, and 12 and standardized within the sample at each round. One child drops compared to previous sample due to missing data in 2009.

Table 8: PSNP impact on PPVT: Fixed effects estimates

	Broad control group		Restricted control group	
	(1)	(2)	(3)	(4)
PSNP	0.366***	0.346***	0.301***	0.285***
	(0.070)	(0.071)	(0.062)	(0.063)
Wealth Index: mid tercile	-0.063	-0.062	-0.070	-0.068
	(0.067)	(0.067)	(0.058)	(0.058)
Wealth Index: top tercile	-0.031	-0.028	0.013	0.013
	(0.104)	(0.104)	(0.083)	(0.083)
Age (in months)	0.021***	0.021***	0.022***	0.022***
	(0.001)	(0.001)	(0.001)	(0.001)
Drought		0.012		0.042
		(0.079)		(0.068)
Flood		0.034		0.028
		(0.092)		(0.078)
Crop Failure		0.144*		0.105
		(0.075)		(0.065)
Illness of household member		0.179*		0.172**
		(0.093)		(0.078)
Number of shocks		-0.054		-0.054
		(0.053)		(0.045)
Constant	-1.598***	-1.633***	-1.594***	-1.632***
	(0.069)	(0.094)	(0.057)	(0.074)
Observations	1,698	1,698	2,456	2,456
R-squared(within)	0.593	0.596	0.588	0.590
Number of children	567	567	823	823

Notes: The table reports child fixed effects estimates with standard errors (reported in parentheses) clustered at community level. * $p<0.1$ ** $p<0.05$ *** $p<0.01$. The dependent variable is the PPVT score measured at the age of 5,9 and 12 and standardized within the sample/round using Item Response Theory (Leon and Singh, 2017). One child drops compared to previous sample due to missing data in 2009.

Table 9: Mechanisms (using restricted control group)

	Control		2009 PSNP		2009 & 13 PSNP		T-tests C-2009 PSNP	C-2009&13 PSNP	2009-2009&13 PSNP
	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev	p-value	p-value	p-value
Shocks									
Drought	0.26	0.032	0.26	0.037	0.24	0.027	0.982	0.578	0.594
Flood	0.17	0.027	0.05	0.018	0.09	0.019	0.001	0.019	0.126
Crop failure	0.29	0.033	0.31	0.039	0.37	0.031	0.628	0.078	0.272
Illness of hh member	0.21	0.029	0.16	0.031	0.21	0.026	0.267	0.958	0.227
Number of shocks	1.04	0.091	0.87	0.096	0.99	0.066	0.205	0.648	0.291
Time use (hours)									
Working	5.12	0.153	4.91	0.130	4.92	0.128	0.340	0.320	0.982
Schooling	5.19	0.144	6.09	0.138	5.70	0.113	0.000	0.005	0.037
Studying	1.33	0.065	1.27	0.069	1.24	0.051	0.530	0.238	0.675
Expenditure									
Food expenditure	282.56	9.610	310.71	13.712	264.02	8.835	0.084	0.159	0.003
Non-food expenditure	157.87	14.369	127.82	9.708	103.29	6.561	0.109	0.000	0.032
% expenditure on educ.	0.01	0.001	0.01	0.001	0.01	0.001	0.340	0.608	0.465

Note: All variables are measured in 2013 (round 4). "Working" is defined as the sum of hours spent caring for household members, house chores, unpaid work and paid work.

8 Appendix

Table A.1: Descriptive statistics: using the restricted control group

	Mean	Std. Error	N
Cognitive skills			
PPVT (R4)	1.67	(1.131)	521
PPVT (R2)	-0.32	(0.958)	514
Math (R4)	-0.07	(0.952)	576
Math (R2)	0.00	(0.990)	576
Socio-economic status			
Wealth Index (R2): bottom tercile	0.56	(0.497)	576
Wealth Index (R2): mid tercile	0.36	(0.479)	576
Wealth Index (R2): top tercile	0.08	(0.277)	576
Mother's education: primary and above	0.41	(0.492)	576
Demographics			
Male	0.54	(0.499)	576
Age (in months) at R4	145.48	(4.030)	576
Shocks in R3			
Drought	0.59	(0.493)	576
Flood	0.20	(0.401)	576
Crop Failure	0.47	(0.499)	576
Illness of household member	0.44	(0.497)	576
Death of father	0.04	(0.196)	576
Death of mother	0.04	(0.200)	576
Number of shocks	2.01	(1.334)	576
Shocks in R4			
Drought	0.25	(0.435)	576
Flood	0.11	(0.310)	576
Crop Failure	0.33	(0.471)	576
Illness of household member	0.19	(0.396)	576
Number of shocks	0.98	(1.137)	576
Time use (Hours spent on) (R4)			
Working (per day)	4.98	(1.939)	576
Schooling (per day)	5.63	(1.848)	576
Studying outside school (per day)	1.28	(0.833)	576
Expenditures (R4)			
Food expenditure (Constant Birr)	281.49	(143.709)	576
Non-food expenditure (Constant Birr)	127.26	(145.435)	576
% expenditure on education	0.01	(0.015)	576

Table A.2: Fixed effects model results: by gender

	Maths (z-score)				PPVT (IRT)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Female	Male	Female	Male	Female	Male	Female	Male
Restricted sample								
PSNP	0.130	0.328***	0.076	0.334***	0.475***	0.274***	0.416***	0.416***
	(0.106)	(0.100)	(0.110)	(0.103)	(0.100)	(0.097)	(0.102)	(0.102)
Controls			Y	Y			Y	Y
Observations	795	907	795	907	758	940	758	758
R-squared	0.023	0.038	0.038	0.047	0.640	0.557	0.646	0.646
Broad sample								
PSNP	0.101	0.145*	0.056	0.117	0.443***	0.182**	0.410***	0.176**
	(0.093)	(0.088)	(0.094)	(0.089)	(0.092)	(0.084)	(0.093)	(0.085)
Controls			Y	Y			Y	Y
Observations	1,273	1,527	1,273	1,527	1,097	1,359	1,097	1,359
R-squared	0.024	0.024	0.039	0.035	0.604	0.577	0.608	0.580

Notes: Specifications as in table 7 and 8.